REMARKS

Reconsideration and allowance are requested.

The inventors recognized that there is an inherent time delay between the time instant when a mobile user reports a current channel quality, e.g., in the form of a channel quality indicator (CQI), and the time instant that the base station schedules downlink transmission over a high speed shared channel to a mobile user. During this time delay, the interference may change dramatically. If the difference between the reported channel quality and the actual channel quality at the time of scheduling is large, the selected coding and modulation scheme may not be sufficiently robust to ensure transmission with a low enough error rate. If the data is received in error, the mobile radio requests retransmission which degrades system performance.

This difference between a reported CQI and the actual CQI at a scheduled high speed shared channel transmission is particularly problematic in adaptive antenna systems. An adaptive antenna system can change its beam characteristics in response to changes in the network. Because the base station can detect the direction of a mobile station, it can transmit dedicated information in an antenna beam towards the desired mobile station. By directing the signal just toward its recipient, the interference in the network can be substantially reduced. Adaptive antennas can significantly increase the data capacity in a cellular radio network.

The discrepancy between the reported channel quality and the instantaneous channel quality caused by scheduling different mobile users to receive transmissions over a shared radio channel may be traced in large part to a "flashlight effect." The flashlight effect is described in detail in conjunction with Figures 1, 2, 3, and 4. In essence, the flashlight effect is intense interference detected by a mobile causing that mobile to report a low CQI for a short time period which results from the mobile being "flashed" by a brief downlink transmission to another

scheduled mobile. But after that short flash, the mobile may very well have a very good channel quality leading to erroneous scheduling selections. The flashlight effect is a serious problem in fixed multi-beam systems, adaptive antenna systems, and transmit diversity systems.

The inventors devised technology to overcome the flashlight effect by selecting multiple mobile radios to receive a transmission over a shared radio channel during a predetermined transmission time interval. See for example Figure 6 in this application. The shared radio channel radio resources are allocated to the multiple mobile radios using a resource allocation scheme. An optimal coding and modulation scheme is preferably selected for each scheduled mobile radio to achieve an acceptable error rate. Information is transmitted over the shared radio channel to the multiple mobile radios using multiple antenna beams so that interference from the transmission appears as white additive Gaussian noise in time and in space in the cell. In this way, the flashlight effect caused by a single beam transmission over the shared channel that would detrimentally impact a mobile radio's detection of channel quality is avoided.

But splitting the resources amongst multiple beams during one TTI lowers the peak bit rate because the transmit power per beam largely impacts the achievable bit rate. The highest peak bit rate is achieved by allocating all transmit power resources to one beam in a cell. Yet, as just described above, a single beam allocation—without careful planning—causes the flashlight effect. But by carefully planning in space and/or in time which beam is used for transmission, the flashlight effect may be avoided. The flashlight effect may be avoided by carefully planning in space and/or in time which beam is used for transmission.

Another technique for avoiding the flashlight effect employs a beam transmission sequence order. Multiple mobile radios may be selected to receive a transmission over a shared radio channel using a beam transmission sequence order. Mobile users belonging to a selected

beam may be scheduled. The beam selection is decided using a beam sequence number. Information is transmitted over the shared radio channel to each of the mobile radios in the cell following the beam transmission sequence order. Beam switching in accordance with the beam transmission sequence order occurs over multiple transmission time intervals so that interference from the transmission appears as white noise in time and in space.

Claims 1-13 stand rejected under 35 U.S.C. §103 for obviousness based on Ishii and Schmidl. The rejection is respectfully traversed.

Ishii is focused on improving the throughput in a mobile communication system. A 3-sector base station 1 sends wider, omni-type antenna beams (101-103) to broadcast over a common pilot channel. Narrower, directed beams 201 are used for individual control and data channels with a particular mobile station 2. The mobile station 2 switches between the common pilot channel and the individual control channel from the base station 1 for estimating the communication path quality.

The Examiner admits that Ishii lacks a teaching of "transmitting information over the shared radio channel to the multiple mobile radios in the cell during the predetermined transmission time interval using multiple antenna beams so that interference from the transmission appears as white noise in time and in space." Reference is made to Schmidl at paragraphs [0023] and [0024] allegedly teaching this feature. Applicants respectfully disagree.

Schmidl describes soft estimate normalization for a weighted, multi-antenna, high-order modulation data channel together with separate antenna pilot channels using averaging in first time slots of a transmission time interval with corrections for subsequent time slots (taken from the abstract). Paragraph [0020] discloses the goal of optimizing a DSCH transmission to the mobile user by having the base station adjust the phase and possibly the amplitude of the data

signal to an antenna 1 and antenna 2 using normalization weights w_1 and w_2, respectively. The mobile user provides feedback to the base station for weighting adjustments. Paragraph [0023] simply describes an equation for received data symbols r:

r(1,k) = (w11h11 + w21h21)s(1,k) + n(1,k)

The Examiner points to the white noise n. But this white noise corresponds to background noise already present in the system and not to noise generated by the DSCH transmission. That fact that noise exists in a received signal is not a teaching of interference from the transmission being controlled so that it appears as white noise in time and in space. To further emphasize this distinction, claim 1 as amended also explains "that interference from the transmission is substantially equally distributed over frequency and in space." (This is not a narrowing amendment because the added language simply defines what those skilled in the art already understand the term "white noise" to mean.) There is no teaching in Schmidl of controlling the DSCH transmission so that the interference that transmission generates either (1) "appears as white noise in time and in space", or (2) "is substantially equally distributed over frequency and in space."

Accordingly, even if the combination of Ishii and Schmidl could be made for purposes of argument only, that combination fails to teach all the features of claim 1. Moreover, Applicants do not understand why a skilled person in the art would have been motivated to modify Ishii to include Schmidl's channel normalization scheme.

Claims 16-22 and 32-33 stand rejected under 35 U.S.C. §103 for obviousness based on Ishii and Frank. The rejection is respectfully traversed.

Frank describes a communication system that schedules a different mobile radio in each beam of multiple predetermined, fixed beams associated with a particular sector. By scheduling a different user for each of the multiple beams, performance and throughput are increased.

The Examiner admits that Ishii lacks a number of claim features listed at the bottom onf page 7 of the office action. In particular, paragraphs [0020-0028] and [0082] are identified as allegedly teaching "transmitting information stored in the one or more transmission buffers over the shared radio channel via the adaptive antenna array to the multiple mobile radios in the cell during the same predetermined transmission time interval using multiple antenna beams to spread out the interference caused by the transmission." Paragraphs [0020-0028] describe a base station with various baseband and radio processings for a CDMA transmitter that employs multiple antennas using switched beamforming to allow the base station to transmit a narrow beam to a target mobile. Each mobile measures the downlink signal quality from the base station (C/I) by correlating a known pilot with a received pilot. The mobile also measures the autocorrelation of the background interference [0028]. The mobile radio determines the background interference by subtracting the demodulated received signal from the received signal. Although the mobile determines a measure of interference on the channel, it is not understood how that is relevant to the base station transmitting information "to the multiple mobile radios in the cell during the same predetermined transmission time interval using multiple antenna beams to spread out the interference caused by the transmission."

Paragraph [0082] describes actually transmitting:

> CDMA noise (randomly modulated unused Walsh code) on a shared communication channel in order to keep the transmitted power in each of the beams equal and constant and preserve the integrity of the C/I feedback. Transmission of noise may be desirable if either there is no data to transmit on the shared

> communication channel during some time intervals or there are two beams for the shared packet data channel, but there are four beams for 1X voice and data. In this instance, only one of the two of the four beams may be scheduled for the shared communication channel, the other two beams must be filled with noise.

How is adding noise—which is not information—to beams related to transmitting information so as to spread out the interference caused by the transmission of that information? To clarify this distinction, claim 16 recites that the "interference from the transmission is substantially equally distributed over frequency and in space." Frank's adding noise to empty beams but not to other beams that are carrying information is clearly not relevant.

Claims 15, 31, and 34-37 which relate to the flashlight effect stand rejected based on some combination of Ishii, Schmidl, and/or Frank with Kanemoto. This rejection is respectfully traversed.

Kanemoto describes estimating the direction of arrival of a signal and selecting a communication terminal to use a DSCH based on the signal direction of arrival. Mobiles whose signal directions of arrival are most contiguous from among communication terminals wishing to use the DSCH are selected. The Examiner relies on column 15, line 57-column 16, line 15 as allegedly teaching: "performing beam switching in accordance with the beam transmission sequence order after multiple transmission time intervals so that the flashlight effect is avoided." Applicants disagree.

The text identified in Kanemoto by the Examiner relates to Figure 15 which shows a nondirectional transmission area 201. A communication terminal #1 is first assigned as a group representative terminal to receive a transmission on the DSCH. Based on direction of arrival estimation results, terminals transmitting a signal that arrives from a direction within a predetermined range of angles with reference to the direction of arrival of a signal transmitted

from communication terminal #1 are included in that group. That group 1401 includes MS #1 and MS #2. "The size of the predetermined range of angles with reference to a signal transmitted from a representative terminal is set taking the balance between the number of times transmission directivity is switched and the decrease in interference due to transmission directivity formation into consideration." 15:57-62. Kanemoto further explains that the more communication terminals belonging to the same group, the less the interference power received from a DSCH signal changes suddenly in a communication terminal located in the vicinity of a communication terminal to which the DSCH is assigned.

Kanemoto does not teach performing beamswitching in accordance with the beam transmission sequence order after multiple transmission time intervals so that the flashlight effect is avoided. Instead, Kanemoto teaches grouping as many mobiles as practical into the same group in the hope of reducing the number of times that flashlight type interference affects terminals "in the vicinity" of the DSCH-assigned terminals. The flashlight effect itself is not avoided. It still occurs, only hopefully with less frequency. The mobiles that are flashed in Kanemoto return reports to the base station of lower signal quality because of that flashlight effect occurring. Reducing the frequency of flashlight interference is not the same as avoiding the flashlight interference as claimed.

In addition, claim 34 actively performs beamswitching over multiple transmission time intervals to avoid the flashlight effect. In contrast, Kanemoto refrains from beam switching for as long as possible in order to reduce the number of times the flashlight effect occurs. Claims 15 and 31 recite "wherein the transmission via the adaptive antenna array to multiple mobile radios in the cell during the same predetermined transmission time interval using multiple antenna beams prevents a flashlight effect from disrupting the channel quality detection performed by the

mobile radios." Kanemoto does not prevent the flashlight effect; nor does Kanemoto teach using multiple antenna beams to do so (Figure 15 shows that only one antenna beam is selected for transmission during the transmission time interval).

The obviousness rejections are improper and must be withdrawn. Accordingly, the application is in condition for allowance. An early notice to that effect is respectfully requested.

Respectfully submitted,

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